Heavy Quark Measurements by Weak-Decayed Electrons at RHIC-PHENIX

Fukutaro Kajihara[1] for the PHENIX Collaboration

[1] Center for Nuclear Study (CNS), Graduate School of Science, the University of Tokyo

Contact e-mail: kajihara@bnl.gov

In modern nuclear and elementary particle physics, Quantum ChromoDynamics (QCD) is the only theory to describe behaviors of strong interacting quarks and gluons. The theory has two kinds of important properties: “color deconfinement” and “asymptotic freedom”. In low energy, quarks and gluons, which have a degree of freedom of color, are confined as color-singlets in hadrons. On the other hand, strong coupling constant (α_s) can be decreased by large momentum transfer at high energy reaction, or the environment of extremely high temperature or density. The two aspects of QCD provide an interesting scenario: as the temperature or density of many-body system of hadrons are increased, color confinement can be broken by the nature of asymptotic freedom. Such an effect can cause a phase transition into a new state of matter, called “Quark Gluon Plasma” (QGP). Many heavy-ion experiments attempted to create such an extreme state so far.

Recently, we have growing evidences that unconventional matter is formed in $\sqrt{s_{NN}} =$ 200 GeV Au+Au collisions at Relativistic Heavy Ion Collider (RHIC) in Brookhaven National Laboratory (BNL), United States [1]. Strong suppression observed for π^0 and the other light hadrons at high transverse momentum (p_{T}) indicates a “jet quenching effect”, where high-p_{T}-scattered partons suffer a significant energy loss by gluon radiations in an extremely dense matter [2, 3]. This effect reveals the created matter is very dense and strongly interacting. The observed azimuthal anisotropy, $v_2(p_{\mathrm{T}})$ for light hadrons [4] and the recent hydrodynamical calculations [5] indicate that the matter is thermalized in a very early stage of the collision and the collective motion develops [6].

Heavy quarks (charm/bottom) are also very interesting probes for the matter formed in heavy-ion collisions. Heavy quarks are produced in the initial hard collisions via gluon fusion and propagate through the the created medium. They can interact with the medium in different ways from light quarks and gluons due to their heavy mass. There are theoretical predictions that the energy loss of heavy quarks is smaller than that of light quarks and gluons [7]. The heavy quark measurement can extend our knowledge of underlying QCD properties in such extreme state of the matter. To measure heavy quarks, we performed an indirect measurement in the PHENIX experiment, which is to measure single electrons ($0.3 < p_{\mathrm{T}} < 9$ [GeV/c]) from weak decays of heavy quarks at midrapidity ($|\eta| < 0.35$) in Au+Au collisions at $\sqrt{s_{NN}} = 200$ GeV (RHIC Year-4 Run). This talk will present the latest results from the PHENIX experiment with much higher precision than the previous measurement.

1. K. Adcox *et al*, Nucl. Phys., **A757**, 184, (2005)
2. K. Adcox *et al*, Phys. Rev. Lett., **88**, 022301, (2002)
3. S. S. Adler *et al*, Phys. Rev. Lett., **91**, 072301, (2003)
4. S. S. Adler *et al*, Phys. Rev. Lett., **91**, 182301, (2003)
5. P. Huovinen *et al*, Phys. Lett. **B503**, 58, (2001)
6. R. J. Fries *et al*, Phys. Rev. **C68**, 044902, (2003)
7. Y. L. Dokshitzer and D. E. Kharzeev, Phys. Lett. **B519**, 199, (2001)